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Exhibit R-2, RDT&E Budget Item Justification: PB 2012 Air Force **DATE:** February 2011

APPROPRIATION/BUDGET ACTIVITY 3600: <i>Research, Development, Test & Evaluation, Air Force</i> BA 2: <i>Applied Research</i>				R-1 ITEM NOMENCLATURE PE 0602601F: <i>Space Technology</i>							
COST (\$ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
Total Program Element	117.324	111.857	115.285	-	115.285	114.885	119.442	125.677	128.067	Continuing	Continuing
621010: <i>Space Survivability & Surveillance</i>	52.736	48.216	43.259	-	43.259	42.315	42.214	42.628	43.435	Continuing	Continuing
624846: <i>Spacecraft Payload Technologies</i>	16.545	20.299	21.601	-	21.601	21.767	20.705	17.846	18.188	Continuing	Continuing
625018: <i>Spacecraft Protection Technology</i>	6.505	7.556	5.922	-	5.922	7.249	8.723	9.944	10.125	Continuing	Continuing
628809: <i>Spacecraft Vehicle Technologies</i>	41.538	35.786	44.503	-	44.503	43.554	47.800	55.259	56.319	Continuing	Continuing

Note

In FY 2011, increases in funding are due to the movement of technologies from PE 0603401F, Advanced Spacecraft Technology, to this PE in order to better align the technology readiness levels of these efforts.

A. Mission Description and Budget Item Justification

This PE focuses on four major areas. First, space environmental protection develops technologies to understand, mitigate, and exploit effects of weather and geophysics environments on the design and operation of Air Force systems. Second, spacecraft payload technologies improve satellite payload operations by investigating advanced component and subsystem capabilities. Third, spacecraft protection develops technologies for protecting U.S. space assets in potential hostile settings. The last major area, spacecraft vehicles, focuses on spacecraft platform and control technologies, and their interactions. Efforts in this program have been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary space technologies.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2012 Air Force				DATE: February 2011		
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE				
3600: Research, Development, Test & Evaluation, Air Force		PE 0602601F: Space Technology				
BA 2: Applied Research						
B. Program Change Summary (\$ in Millions)		FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Previous President's Budget		119.125	111.857	117.238	-	117.238
Current President's Budget		117.324	111.857	115.285	-	115.285
Total Adjustments		-1.801	-	-1.953	-	-1.953
• Congressional General Reductions			-			
• Congressional Directed Reductions			-			
• Congressional Rescissions		-	-			
• Congressional Adds			-			
• Congressional Directed Transfers			-			
• Reprogrammings		-	-			
• SBIR/STTR Transfer		-1.665	-			
• Other Adjustments		-0.136	-	-1.953	-	-1.953
Congressional Add Details (\$ in Millions, and Includes General Reductions)						
Project: 621010: Space Survivability & Surveillance						
Congressional Add: AFRL Seismic Research Program.						
Congressional Add Subtotals for Project: 621010						
Project: 624846: Spacecraft Payload Technologies						
Congressional Add: Reconfigurable Electronic and Non-Volatile Memory Research.						
Congressional Add Subtotals for Project: 624846						
Project: 628809: Spacecraft Vehicle Technologies						
Congressional Add: Center for Solar Electricity and Hydrogen.						
Congressional Add: Advanced Modular Avionics for Operationally Responsive Satellite Use.						
Congressional Add: Center for Space Entrepreneurship.						
Congressional Add: Mission Design and Analysis Tool.						
Congressional Add Subtotals for Project: 628809						
Congressional Add Totals for all Projects						

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Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force								DATE: February 2011			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research				R-1 ITEM NOMENCLATURE PE 0602601F: Space Technology				PROJECT 621010: Space Survivability & Surveillance			
COST (\$ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
621010: Space Survivability & Surveillance	52.736	48.216	43.259	-	43.259	42.315	42.214	42.628	43.435	Continuing	Continuing
A. Mission Description and Budget Item Justification											
This project develops the technologies to exploit the space environment for warfighter's future capabilities. The project focuses on characterizing and forecasting the battlespace environment for realistic space system design, modeling, and simulation, as well as the battlespace environment's effect on space systems' performance. It includes technologies to specify and forecast the environment from 'mud to sun' for planning operations and ensuring uninterrupted system performance, optimize space-based surveillance operations, and allow the opportunity to mitigate or exploit the space environment for both offensive and defensive operations. Finally, this project includes the seismic research program that supports national requirements for monitoring nuclear explosions.											
B. Accomplishments/Planned Programs (\$ in Millions)							FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Title: Major Thrust 1.							8.109	8.800	7.662	-	7.662
Description: Develop technologies for specifying, monitoring, predicting, and controlling space environmental conditions hazardous to Department of Defense (DoD) operational space systems.											
FY 2010 Accomplishments: Completed trade studies for measuring coronal and interplanetary magnetic fields using new wide-field radio arrays. Developed empirical flare prediction models and started development of physics-based flare forecast models. Analyzed energetic particle measurements to understand the dynamics of the radiation belts. Investigated new technologies for simulation and mitigation of hazards due to spacecraft electrostatic charging and discharging.											
FY 2011 Plans: Develop improved solar energetic particle models. Complete validation of energetic particle measurements in multiple orbital regimes. Incorporate new simulation technologies into model of spacecraft electromagnetic and plasma environment.											
FY 2012 Base Plans: Complete Improved Solar Observing Optical Network-data-based solar flare prediction tool. Develop a new instrument to measure energetic electrons, ions, and neutral atoms in low earth orbit. Refine and expand models of the radiation belts using new data sets from recently launched spacecraft.											
FY 2012 OCO Plans:											

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Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force				DATE: February 2011		
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602601F: Space Technology		PROJECT 621010: Space Survivability & Surveillance		
B. Accomplishments/Planned Programs (\$ in Millions)						
	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	
Title: Major Thrust 2. Description: Develop spectral signature libraries, target detection techniques, and decision aids for application to space-based sensors and surveillance systems. FY 2010 Accomplishments: Demonstrated aircraft-based detection of large booster missile launch through optically thick sunlit clouds using existing hypertextportal (HT) image processing. Started focused effort on thermal atmospheric model validation and inversion. Initiated development of sensor system to characterize space object orbital maneuver. Developed space-based multi-phenomenology Space Situational Awareness (SSA) sensor payload. Initiated thermal infrared (IR) imaging spectrometer feasibility for space missions. FY 2011 Plans: Demonstrate space-based detection of large booster missile launch through optically thick sunlit clouds. Conduct critical test of maneuver characterization sensor system with go-no-go decision point. Develop multi-phenomenology SSA sensor system for space-based SSA. Continue study of thermal IR imaging spectrometer feasibility for space missions. FY 2012 Base Plans: Investigate space-based HT detection methods. Continue to develop a space-based wide area search sensor system to monitor and characterize resident space objects and maneuver signatures. Refine concepts for space-based thermal IR hyperspectral imaging payloads. Develop atmospheric compensation and temperature-emissivity separation models for space-based thermal infrared hyperspectral imaging. FY 2012 OCO Plans:		12.254	12.854	10.935	-	10.935
Title: Major Thrust 3. Description: Develop techniques, forecasting tools, and sensors for ionospheric specification and forecasting, space-based geolocation demonstrations, and determination of radar degradation. FY 2010 Accomplishments: Developed more capable, less costly ground sensors for ionospheric electron density and scintillation parameters using digital radio technology and newly available satellite signals. Validated Communications/Navigation Outage Forecasting System instruments and products for operational uses. Implemented semi-empirical high-latitude model to couple solar storm effects to the low latitude ionosphere to improve scintillation		9.265	9.115	7.609	-	7.609

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APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602601F: Space Technology		PROJECT 621010: Space Survivability & Surveillance		
B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
forecasts. Assessed ionospheric effects on the performance of lower frequency space-radar applications. Validated scintillation and electron density profiles from radio occultation techniques for operational algorithm development. FY 2011 Plans: Deliver validated algorithm to simulate ionospheric effects on wideband radio frequency waveforms for arbitrary propagation paths to support many applications. Improve assimilative ionospheric nowcast models and identify deficiencies in forecast models. Test physics-based neutral density models forecasting capabilities, particularly during magnetic storms. FY 2012 Base Plans: Investigate methods to exploit grid-free calculations of plasma processes in the magnetosphere and ionosphere, as well as in the solar atmosphere and solar wind. Study energy flow between solar and terrestrial environments. Study plasma instabilities and plasma processes in the equatorial and solar ionospheres. Incorporate coupled physics-based models into space weather forecasts. FY 2012 OCO Plans:						
Title: Major Thrust 4. Description: Develop High-frequency Active Auroral Research Program (HAARP) site transmitting and diagnostic instrument infrastructure. FY 2010 Accomplishments: Conducted research to mitigate charged particle effects on space systems and operations with coordinated Demonstration and Science Experiment (DSX) satellite studies and feedback from physical models. FY 2011 Plans: Conduct research programs to develop controlled processes of triggered optical and infrared emissions and radio scintillation for potential DoD applications. Develop experiment using DSX satellite and HAARP based on studies and feedback from physical models. FY 2012 Base Plans: Conduct research to characterize the interactions of radio waves and charged particles in the earth's radiation belts, using DSX satellite experiments. Conduct applications-related demonstrations exploiting ionosphere ducts for very long range, beyond the horizon, communications and surveillance purposes. Develop Radiation Belt		12.020	11.059	10.902	-	10.902

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Remediation (RBR) end-to-end model and validate to improve understanding of wave particle interaction, space transmitter, and lightning phenomenology.						
FY 2012 OCO Plans:						
Title: Major Thrust 5.		6.109	6.388	6.151	-	6.151
Description: Develop seismic technologies to support national requirements for monitoring nuclear explosions with special focus on regional distances less than 2,000 kilometers from the sensors.						
FY 2010 Accomplishments: Refined and expanded the applicability of different techniques for automated processing of increasing numbers of seismic events. Conducted research on causes of challenges in high-frequency regional discrimination. Integrated results of seismic calibration and observational studies of seismic wave propagation, including propagation in Eurasia, into a unified model. Conducted detailed studies of particular challenge areas in local seismic monitoring.						
FY 2011 Plans: Test and implement refined techniques for automated processing of increasing numbers of seismic events. Test and refine unified model results of seismic calibration and observational studies of seismic wave propagation, including propagation in Eurasia. Conduct detailed studies of particular challenge areas in local seismic monitoring.						
FY 2012 Base Plans: Migrate unified models of seismic calibration and wave propagation in Eurasia to three-dimensional physics-based models. Evaluate the results of using three-dimensional earth models in automated processing of seismic events for some regions of high interest. Test potential improvements in high-frequency regional discrimination. Continue detailed studies of particular challenge areas in local seismic monitoring.						
FY 2012 OCO Plans:						
Accomplishments/Planned Programs Subtotals		47.757	48.216	43.259	-	43.259
		FY 2010	FY 2011			
Congressional Add: AFRL Seismic Research Program.		4.979	-			

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	FY 2010	FY 2011
FY 2010 Accomplishments: Conducted Congressionally-directed effort.		
FY 2011 Plans:		
Congressional Adds Subtotals	4.979	-

C. Other Program Funding Summary (\$ in Millions)

<u>Line Item</u>	<u>FY 2010</u>	<u>FY 2011</u>	<u>FY 2012</u> <u>Base</u>	<u>FY 2012</u> <u>OCO</u>	<u>FY 2012</u> <u>Total</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• Activity Not Provided: <i>Title Not Provided</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research				R-1 ITEM NOMENCLATURE PE 0602601F: Space Technology				PROJECT 624846: Spacecraft Payload Technologies				
COST (\$ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost	
624846: Spacecraft Payload Technologies	16.545	20.299	21.601	-	21.601	21.767	20.705	17.846	18.188	Continuing	Continuing	
Note												
NOTE: In FY 2011, increases in funding are due the movement of technologies from PE 0603401F, Advanced Spacecraft Technology, to this PE in order to better align the technology readiness levels of these efforts.												
A. Mission Description and Budget Item Justification												
This project develops advanced technologies that enhance spacecraft payload operations by improving component and subsystem capabilities. The project focuses on four primary areas: (1) development of advanced, space-qualified, survivable electronics, and electronics packaging technologies; (2) development of advanced space data generation and exploitation technologies, including infrared, Fourier transform hyperspectral imaging, polarimetric sensing, and satellite antenna subsystem technologies; (3) development of high-fidelity space simulation models that support space-based surveillance and space asset protection research and development for the warfighter; and (4) development of advanced networking, radio frequency, and laser communications technologies to support next generation satellite communication systems.												
B. Accomplishments/Planned Programs (\$ in Millions)								FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Title: Major Thrust 1.								3.901	4.207	6.099	-	6.099
Description: Develop advanced infrared device technologies that enable hardened space detector arrays with improved detection to perform acquisition, tracking, and discrimination of space objects.												
FY 2010 Accomplishments: Expanded investigation of spectral agility to longer wavelengths. Expanded investigation of field enhancement technologies. Completed final demonstration of optical amplification using quantum interference.												
FY 2011 Plans: Demonstrate tuning from 15 to 20 microns in 1 micron increments. Demonstrate field enhancement technology. Complete predictive capability for next generation of large format technology challenges. Initiate predictive capability for next generation of large format detector array and readout array technology challenges. Begin space object remote characterization study.												
FY 2012 Base Plans: Expand predictive capability for next generation large format detector array and readout array technology challenges toward Wide Area, Global Access Detection and Tracking. Further explore space object remote												

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B. Accomplishments/Planned Programs (\$ in Millions)			FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
characterization for adaptive, comprehensive space situational awareness (SSA). Study effects of surface roughness on distant object polarization signature. Develop methodologies and technologies for on-orbit payload calibration and planning, emphasizing electro-optical payloads. FY 2012 OCO Plans:							
Title: Major Thrust 2. Description: Develop spectral sensing and data exploitation methodologies for military imaging and remote sensing applications. FY 2010 Accomplishments: Completed validation of advanced imaging technology predictive models for SSA concepts of operation. Advanced simulation capability to enhance accuracy and usability of these models. FY 2011 Plans: Further refine models for space-based spectral imaging to include additional space-based situational awareness imaging concepts and operationally responsive SSA scenarios. FY 2012 Base Plans: Continue analysis and basic experimentation in new sensing methods using radio frequency (RF) bands, polarimetry, and non-traditional interferometric techniques. FY 2012 OCO Plans:			3.828	5.485	5.388	-	5.388
Title: Major Thrust 3. Description: Develop technologies for space-based payload components such as radiation-hardened electronic devices, micro-electro-mechanical system devices, and advanced electronics packaging. FY 2010 Accomplishments: Initiated study of phase change materials and began to develop new classes of electronics that enable efficient analog computing. Developed methods of hardening generation-after-next electronic devices to enable a factor of two increases in computing performance. Incorporated nanoelectronic devices into new classes of detectors and transistors to enable terahertz operation. Investigated development of radiation hardened plug-and-play interface module to support rapid development or reconfiguration of spacecraft hardware. FY 2011 Plans:			3.411	5.241	4.866	-	4.866

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APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research		R-1 ITEM NOMENCLATURE PE 0602601F: Space Technology		PROJECT 624846: Spacecraft Payload Technologies		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Apply the basic physical understanding of the operation of phase change materials to analog computing and device trimming applications. Transition radiation mitigation processes using minimally invasive techniques into libraries at major commercial foundries at the 95 nanometer (nm) and 65nm nodes. Initiate program to capitalize on high performance thermoelectric cooling devices applied to focal plane arrays. FY 2012 Base Plans: Investigate high power microwave hardening techniques for satellite systems to develop methodologies to mitigate against narrowband high power microwaves in a wide frequency band. Begin research on advanced system-on-chip integration for improved performance of space sensor systems. Complete development of radiation hardened plug-and-play interface module for reconfigurable spacecraft hardware. Initiate development of integrated modules using three-dimensional techniques to reduce size, weight, and power and increase performance. FY 2012 OCO Plans:						
Title: Major Thrust 4. Description: Modeling and simulation tools for space-based ground surveillance systems, rendezvous and proximity operations, imaging of space systems, distributed satellite architecture, and space control payloads. FY 2010 Accomplishments: Completed SSA detection analysis tools and began developing engineering and military utility models for object identification to support SSA and defensive space control (DSC). Refined development of first-generation decision support tools for space superiority. Finalized software system testbed. Began testing of tools on testbed. Began development of resource management tools for space superiority. FY 2011 Plans: Begin development of engineering, military utility, and cost tools that model object characterization for space superiority analysis of SSA and DSC technologies. Integrate data from flight experiments to refine simulations. Finish development of first-generation decision support tools for space superiority. Expand testbed to include resource management testing capability. FY 2012 Base Plans:		3.699	4.481	4.697	-	4.697

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APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	R-1 ITEM NOMENCLATURE PE 0602601F: Space Technology	PROJECT 624846: Spacecraft Payload Technologies				
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Develop engineering and military utility models for space superiority analysis of SSA and defensive operations technologies. Support autonomous and responsive space flight experiments with cost modeling and trade studies. FY 2012 OCO Plans:						
Title: Major Thrust 5. Description: Develop technologies for next-generation space communications terminals and equipment and methods/techniques to enable future space system operational command and control concepts. FY 2010 Accomplishments: Began development of engineering model of critical technology to satellite communication and ground terminals. FY 2011 Plans: Complete engineering model and select technology for space experiment on enhanced communication platform. FY 2012 Base Plans: Research technologies/components that support optical communication, reconfigurable and cognitive communication, advanced RF communication, and communication security to increase the capacity and flexibility of current and future space protected communication system concepts. FY 2012 OCO Plans:		0.909	0.885	0.551	-	0.551
Accomplishments/Planned Programs Subtotals		15.748	20.299	21.601	-	21.601
		FY 2010	FY 2011			
Congressional Add: Reconfigurable Electronic and Non-Volatile Memory Research. FY 2010 Accomplishments: Conducted Congressionally-directed effort. FY 2011 Plans:		0.797	-			
Congressional Adds Subtotals		0.797	-			

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C. Other Program Funding Summary (\$ in Millions)

<u>Line Item</u>	<u>FY 2010</u>	<u>FY 2011</u>	<u>FY 2012</u> <u>Base</u>	<u>FY 2012</u> <u>OCO</u>	<u>FY 2012</u> <u>Total</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• Activity Not Provided: <i>Title Not Provided</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research				R-1 ITEM NOMENCLATURE PE 0602601F: Space Technology				PROJECT 625018: Spacecraft Protection Technology			
COST (\$ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
625018: Spacecraft Protection Technology	6.505	7.556	5.922	-	5.922	7.249	8.723	9.944	10.125	Continuing	Continuing
A. Mission Description and Budget Item Justification											
This project develops the technologies for protecting U.S. space assets in potential hostile environments to assure continued space system operation without performance loss in support of warfighter requirements. The project focuses on identifying and assessing spacecraft system vulnerabilities, developing threat warning technologies, and developing technologies to mitigate the effects of both intentional and unintentional threats.											
B. Accomplishments/Planned Programs (\$ in Millions)							FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Title: Major Thrust 1.							6.505	7.556	5.922	-	5.922
Description: Develop satellite threat warning technologies and tools for space defense. Exploit on-board inherent satellite resources, satellite-as-a-sensor, and self-aware satellite technologies.											
FY 2010 Accomplishments: Explored capabilities of potential defensive subsystems through laboratory testing. Developed techniques to exploit existing satellite sensors for defense.											
FY 2011 Plans: Complete laboratory testing of potential defensive subsystems. Develop performance goals using engineering models. Transition dual usage sensor technology to multiple satellite systems.											
FY 2012 Base Plans: Develop technologies for on-orbit threat detection, assessment, and response, including development of algorithms for pursuit-evasion, space-based tasking, and co-orbital threat detection. Reduce size, weight, and power requirements for next generation proximity detection sensors.											
FY 2012 OCO Plans:											
Accomplishments/Planned Programs Subtotals							6.505	7.556	5.922	-	5.922

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C. Other Program Funding Summary (\$ in Millions)

<u>Line Item</u>	<u>FY 2010</u>	<u>FY 2011</u>	<u>FY 2012</u> <u>Base</u>	<u>FY 2012</u> <u>OCO</u>	<u>FY 2012</u> <u>Total</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• Activity Not Provided: <i>Title Not Provided</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research				R-1 ITEM NOMENCLATURE PE 0602601F: Space Technology				PROJECT 628809: Spacecraft Vehicle Technologies			
COST (\$ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
628809: Spacecraft Vehicle Technologies	41.538	35.786	44.503	-	44.503	43.554	47.800	55.259	56.319	Continuing	Continuing
Note NOTE: In FY 2011, increases in funding are due to realignment of technologies from PE 0603401F, Advanced Spacecraft Technology, to this PE in order to better align the technology readiness levels of these efforts.											
A. Mission Description and Budget Item Justification This project focuses on three major space technology areas: spacecraft platforms (e.g., structures, controls, power, and thermal management); satellite control (e.g., signal processing and control); and space experiments of maturing technologies for space qualification.											
B. Accomplishments/Planned Programs (\$ in Millions)							FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Title: Major Thrust 1. Description: Develop technologies for advanced space platform subsystems such as cryocoolers, compact, high efficiency solar power cells and arrays, and innovative power generation concepts. FY 2010 Accomplishments: Refined and validated cryocooler component and system models with experimental data. Completed models/validation of pulse tube and started models/validation of inertance tube, regenerator, and compressor. Investigated thermodynamic loss mechanisms in regenerative cycle cryocoolers through computational fluid dynamics (CFD) models, including two-stage pulse-tube cryocoolers and multi-stage coolers from 110 degrees Kelvin to 10 degrees Kelvin. Developed subcell technology for thin-film tandem solar cell traceable to greater than 20% efficiency. Explored the development of material growth and device structures for solar cells traceable to 40% or higher ultra-high efficiency solar cells. FY 2011 Plans: Complete cryocooler component and system models with experimental data, and begin to analyze cryocoolers as a single unit. Begin to develop full-scale design equations for cryocoolers, increasing efficiency by 20% and decreasing manufacturing time by 200%. Demonstrate integrated, monolithic thin-film tandem solar cell. Demonstrate subcomponents of ultra high efficiency solar cell. FY 2012 Base Plans:							4.543	4.792	7.583	-	7.583

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Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force			DATE: February 2011			
APPROPRIATION/BUDGET ACTIVITY 3600: Research, Development, Test & Evaluation, Air Force BA 2: Applied Research	R-1 ITEM NOMENCLATURE PE 0602601F: Space Technology	PROJECT 628809: Spacecraft Vehicle Technologies				
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Increase cryocooler efficiency from 12% to 30% through in-house modeling, energy analysis of single and multi-stage coolers, and distributed cooling. Model spacecraft thermal radiation signature phenomenology to understand the physics of IR sensing of resident space objects. Continue development of materials and concepts for 40% or greater solar cells. Demonstrate cell interconnect and module technologies to enable flexible arrays. FY 2012 OCO Plans:						
Title: Major Thrust 2. Description: Develop revolutionary and enabling technologies, including lighter weight, lower cost, high performance structures for space platforms; guidance, navigation, and controls hardware and software for next generation responsive space and space superiority space systems; and to minimize spacecraft development schedules and cost. FY 2010 Accomplishments: Developed system-level deployable structures for RF frequencies. Initiated development of integrated thermal management subsystems for responsive space class of satellites. Began development of guidance, navigation, and control algorithms for rapid integration and test of satellite hardware. Began development of advanced data association algorithms for space object tracking. Investigated development of modular plug-and-play spacecraft structural panels. FY 2011 Plans: Refine development of integrated thermal management subsystems for responsive space satellites. Develop nano-reinforced structures for space applications. Develop advanced guidance, navigation, and control algorithms for rapid integration and test of satellite hardware. Develop autonomous guidance, navigation, and control algorithms for proximity operations. FY 2012 Base Plans: Complete integrated thermal management subsystem for responsive space satellites. Develop novel technologies for high-efficiency deployable structures for RF frequencies and electro-optical payloads for SSA. Develop automated guidance, navigation, and control subsystem design tools for responsive space. Investigate non-cooperative control techniques for orbital debris removal applications. Develop radiation-hardened plug-		12.350	16.906	15.700	-	15.700

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
and-play electronics to enable rapid spacecraft build and reduce spacecraft cost. Develop technologies for integrated satellite bus checkout and sensor calibration using autonomous flight architecture. FY 2012 OCO Plans:						
Title: Major Thrust 3. Description: Develop flight experiments to improve the capabilities of existing operational space systems and to enable new transformational space capabilities. FY 2010 Accomplishments: Conducted ground-based experiments. Began Demonstration and Science Experiment (DSX) system-level integration and test. Completed DSX payload system-level functional and environmental tests. Developed ground support equipment and software. FY 2011 Plans: Continue ground-based experiments in support of radiation belt remediation technologies. Complete DSX and payload integration and functional/environmental testing for radiation belt remediation payload. Complete development of ground support equipment and software. FY 2012 Base Plans: Complete assembly, integration, and test of the DSX satellite to launch ready. Begin launch readiness preparations, electrical trailblazer, insertion of flight batteries and communications security equipment, and regression testing with satellite operations center in preparation for integration on the launch vehicle. FY 2012 OCO Plans:		15.006	14.088	21.220	-	21.220
Accomplishments/Planned Programs Subtotals		31.899	35.786	44.503	-	44.503
		FY 2010	FY 2011			
Congressional Add: Center for Solar Electricity and Hydrogen. FY 2010 Accomplishments: Conducted Congressionally-directed effort. FY 2011 Plans:		3.983	-			
Congressional Add: Advanced Modular Avionics for Operationally Responsive Satellite Use.		2.470	-			

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APPROPRIATION/BUDGET ACTIVITY 3600: <i>Research, Development, Test & Evaluation, Air Force</i> BA 2: <i>Applied Research</i>	R-1 ITEM NOMENCLATURE PE 0602601F: <i>Space Technology</i>	PROJECT 628809: <i>Spacecraft Vehicle Technologies</i>
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	FY 2010	FY 2011
FY 2010 Accomplishments: Conducted Congressionally-directed effort.		
FY 2011 Plans:		
Congressional Add: Center for Space Entrepreneurship.	1.593	-
FY 2010 Accomplishments: Conducted Congressionally-directed effort.		
FY 2011 Plans:		
Congressional Add: Mission Design and Analysis Tool.	1.593	-
FY 2010 Accomplishments: Conducted Congressionally-directed effort.		
FY 2011 Plans:		
Congressional Adds Subtotals	9.639	-

C. Other Program Funding Summary (\$ in Millions)

<u>Line Item</u>	<u>FY 2010</u>	<u>FY 2011</u>	<u>FY 2012</u> <u>Base</u>	<u>FY 2012</u> <u>OCO</u>	<u>FY 2012</u> <u>Total</u>	<u>FY 2013</u>	<u>FY 2014</u>	<u>FY 2015</u>	<u>FY 2016</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• Activity Not Provided: <i>Title Not Provided</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

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